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An Incidence of Hemlock Engraver, *Scolytus tsugae* (Swaine), in Standing Mountain Hemlock, *Tsuga mertensiana*, in Idaho and Clarification Regarding Previous Synonymy with *S. monticolae* (Swaine)

Sandy Kegley¹, Mal Furniss², and Lee Pederson¹

¹Forest Entomologists, Forest Health Protection, Coeur d' Alene, Idaho


²Research Entomologist, Rocky Mountain Research Station, Moscow, Idaho, retired

The hemlock engraver, *Scolytus tsugae*, has been considered a secondary bark beetle that normally inhabits shaded-out limbs, slash, and tops of two species of hemlock in the western United States and Canada (Wood 1982). We report an unusual incidence of *S. tsugae* infesting large diameter, standing mountain hemlock, *Tsuga mertensiana*, in northern Idaho for three years following wildfire injury. In addition, we correct misinformation on biology and species designation reported in the literature regarding *S. tsugae* and a closely related species, *S. monticolae*, that occurs on Douglas-fir, *Pseudotsuga menziesii*.

Species Clarification and Misinformation in the Literature

Scolytus tsugae and *S. monticolae* were described as separate species under the genus *Eccoptogaster* (= *Scolytus*) by Swaine (1917). Blackman (1934) kept them as separate species in his revision of the genus *Scolytus* but expressed indecision in assigning specimens that were intermediate between the more coarsely sculptured *S. tsugae* with an opaque ventral abdomen, and the smoothly sculptured *S. monticolae* with a shiny ventral abdomen. McMullen and Atkins (1959) studied the life history and habits of *S. monticolae* in Douglas-fir but referred to them as *S. tsugae*. This resulted from their correspondence with G. R. Hopping, of the Forest Biology Laboratory in Calgary, Alberta, who believed the two taxa were one species with the name *tsugae* taking precedence.

The two species were synonymized by Wood (1966) but he later treated them as valid species in his taxonomic monograph (Wood 1982). Wood's decision that *S. monticolae* was a distinct species occurred after he examined *Scolytus* specimens representing the two species from M.M. Furniss that were collected from Douglas-fir and western hemlock (*Tsuga heterophylla*) at the same Idaho location. Besides morphological differences, Furniss had observed that the egg gallery of *S. monticolae* in Douglas-

United States Department of Agriculture	Forest Service	Northern Region	200 East Broadway P.O. Box 7669 Missoula, MT 59807	
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fir was vertical whereas the egg gallery of *S. tsugae* in western hemlock was horizontal. The two species were validated recently using molecular methods (Smith & Cognato 2014).

Hemlock Engraver in Partially Burned Mountain Hemlock

The Cayuse Fire occurred on the Nez Perce-Clearwater National Forest from August 25 – October 24, 2011. In September 2014, S. Kegley and L. Pederson observed *S. tsugae* infesting about 15 acres of mountain hemlock with root and stem scorch within the Cayuse fire perimeter. The stand was located northeast of Powell, Idaho County, Idaho at 6,448 feet elevation along forest road 500 (B.M., T37N, R13E, sec 4; N 46.58158 W 114.83518) (figure 1, left). Extensive woodpecker activity was evident on many infested trees (figure 1, right). Additional observations were taken 23 June 2015.

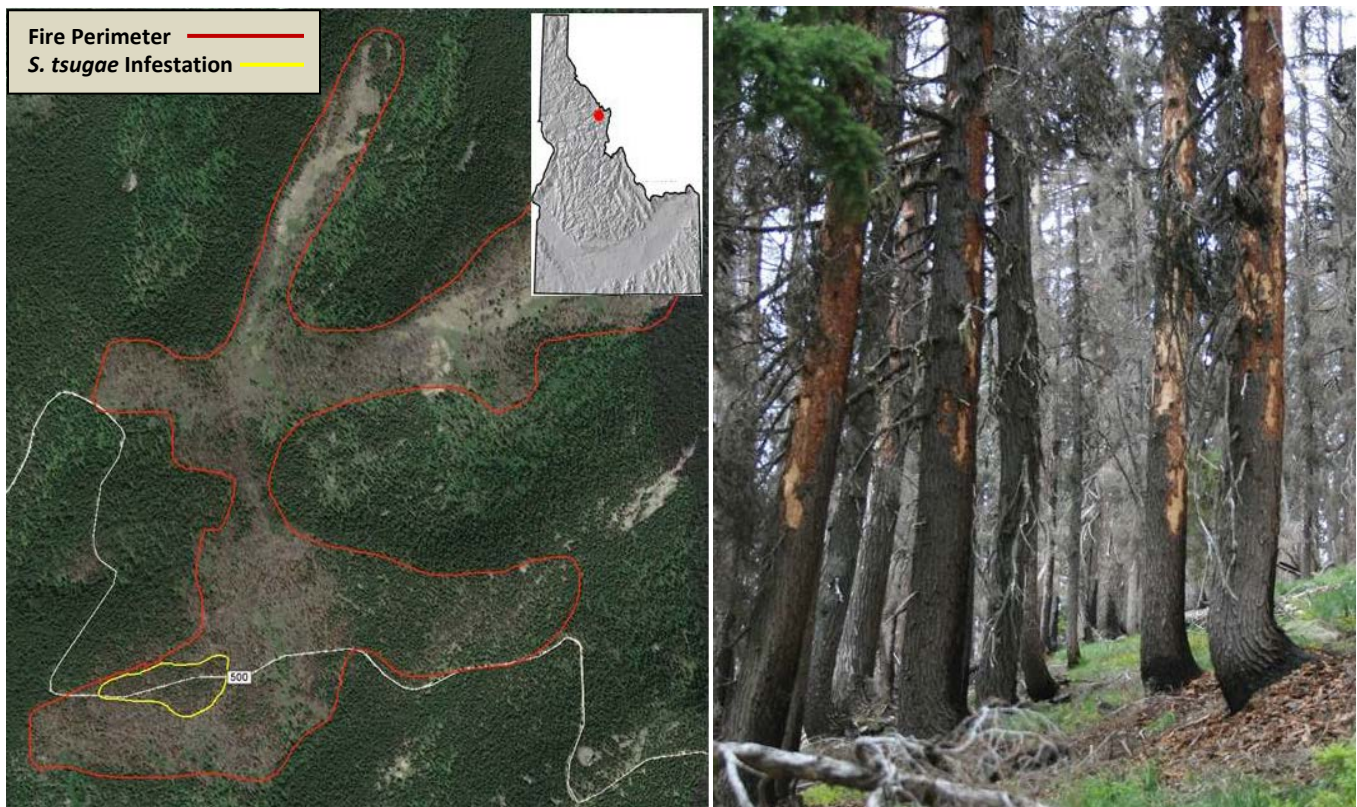


Figure 1. Map of area infested with *Scolytus tsugae* within the perimeter of the Cayuse Fire (left) and woodpecker activity that removed bark on infested mountain hemlocks (right).

Scolytus tsugae infested the partially scorched trees during the summers of 2012, 2013, and 2014. We determined the year of attack visually by the color of the phloem and wood and by the presence of beetle larvae. Trees infested in 2012 had lighter colored, older-appearing wood and galleries than those infested in 2013 (figure 2). Trees infested in 2014 had larvae under or in the bark (figure 3). Some green trees had pitching on the outside of the bark and unsuccessful gallery starts in the phloem (figure 3). Trees that were infested by *S. tsugae* had low to moderate root and lower stem scorch. More severely burned trees were infested by wood borers.



Figure 2. Observations of mountain hemlock in 2014 with evidence of attack by *Scolytus tsugae* in 2012 (left) and 2013 (right).



Figure 3. *Scolytus tsugae* larvae in successful 2014 galleries (left) but lacking in unsuccessful gallery (right).

We obtained stand data by a series of ten variable radius plots located about two chains (132 feet) apart throughout the infested area and used the FINDITS (Forest Insect and Disease Tally System) program (McMahan & Zweifler 2014) to summarize the data. The stand species composition was 94% mountain hemlock, 4% lodgepole pine (*Pinus contorta*), and 2% subalpine fir (*Abies lasiocarpa*). Stand density was 300 trees per acre and 308 ft² basal area. The average diameter and percent trees not attacked, attacked by *S. tsugae* each year after the fire, and attacked by woodborers are shown in table 1. About 18% of mountain hemlocks that survived the fire were not attacked by beetles and 1% were attacked unsuccessfully (figure 3). *Scolytus tsugae* successfully attacked 55% of partially scorched mountain hemlocks within three years while woodborers infested 26%. Most of the tree mortality occurred in the first two years after the fire and *S. tsugae* infestation declined the third year.

Table 1. Average diameter and percent of scorched mountain hemlocks not attacked, attacked by *S. tsugae* one, two, or three years after fire, or attacked by woodborers in any year following the fire.

	Live trees not attacked	<i>S. tsugae</i> attack 2012 (summer after fire)	<i>S. tsugae</i> attack 2013 (2 years after fire)	<i>S. tsugae</i> attack 2014 (3 years after fire)	Woodborer-attacked trees
Average diameter	15.5	14.4	16.0	16.0	15.6
% Mtn. hemlock	18%	25%	25%	5%	26%

Larvae were present in mountain hemlock phloem at this location on 8 Sept 2014 and larvae and pupae were present in the bark when examined on 23 June 2015.

Other Biological Notes

This was the second collection of *S. tsugae* from mountain hemlock in Idaho. The first record was from about 14 miles southwestward on 13 June 1986, from the upper stem and limbs of a downed tree (Furniss and Johnson 2002).

Locations of previous *S. tsugae* collections from mountain hemlock include Yosemite National Park, CA (21 Jul 1918) by J.E. Patterson; and Crater Lake, OR (22 May 1930, 14 Jun 1931, 16 Jun 1931, 20 June 1931, 4 Oct 1931) by W.J. Buckhorn, J.A. Beal, and R.L. Furniss. The Crater Lake collections were from trees felled along a power line right of way or in 10" diameter standing trees with few needles.

Collectors' notes include the only other recorded incidence of woodpecker activity involving *S. tsugae*, in a tree 12 feet in height with sparse, brown foliage. *Scolytus tsugae* was reared and collected from a western hemlock "stick" on the Coeur d'Alene National Forest (7 Aug 1935) by T.T. Terrill (AllWest Forest Insect database for 'Hopkins cards' originating at the former Portland Forest Insect Lab of the Bureau of Entomology, USDA).

In 1968, M.M. Furniss deployed flight traps at various heights in a mixed conifer stand including western hemlock (unpublished data). The study area was located northeast of Coeur d’Alene, Idaho at Deception Creek Experimental Forest (3,000 feet elevation). *Scolytus tsugae* adults were caught from June 26 – August 13 with most beetles caught between June 26 and July 11 (figure 4).

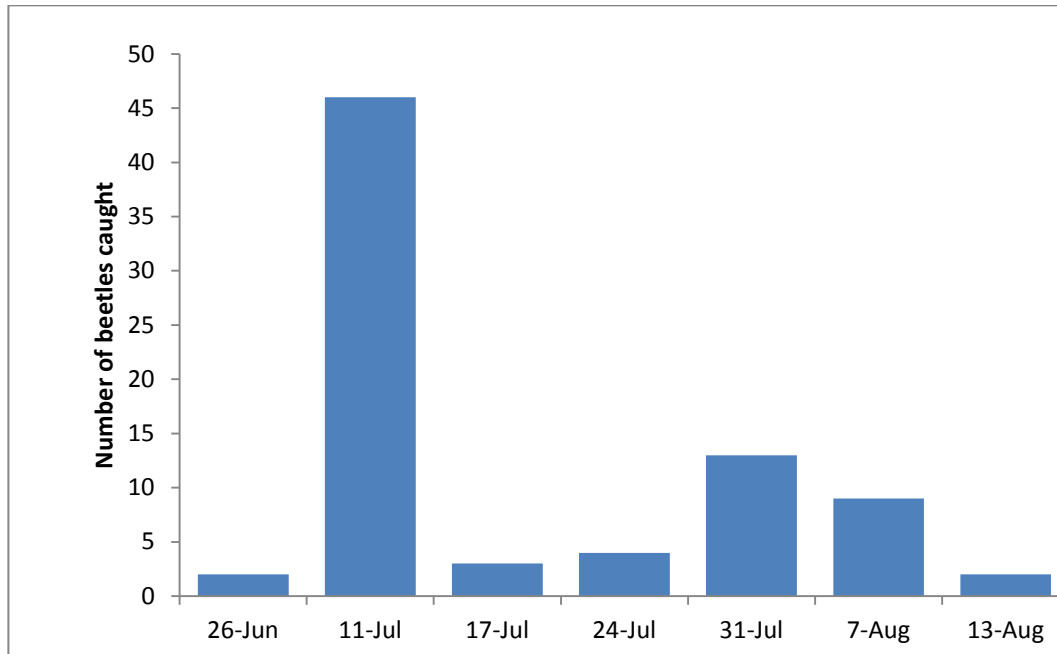


Figure 4. Flight period of *Scolytus tsugae* in a mixed conifer stand in 1968 at Deception Creek Experimental Forest, Idaho.

Our observations provide an example of *S. tsugae*—normally considered secondary and infesting downed trees and slash—attacking live standing trees partially scorched by wildfire, for three years following the fire. Other secondary bark beetles such as *S. monticolae* in Douglas-fir and *Pityophthorus fossifrons* in whitebark pine (*Pinus albicaulis*) have killed trees under drought or fire-weakened conditions (Furniss & Carolin 1977, Egan 2014). As our climate warms and trees are stressed by drought and fire more frequently, the occurrence of secondary bark beetles killing weakened trees will likely increase.

Acknowledgements

Christopher Marshall, Manager of the Western Forest Insect Collection, Oregon State University, provided collection and rearing records of *S. tsugae* from Hopkins cards. Matt Young, FMO, and Brandon Cichowski, AFMO, of the Powell Ranger District provided information on the Cayuse Fire, road condition updates and local arrangements.

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